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Influence of plant growth regulator application and nitrogen fertilization on oat yield and stand-ability.

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Introduction

Canada is the world's third largest producer of oats next to the European Union (EU) and Russia. In 2014, only 3.5% of cultivated acres in Alberta were seeded to oat[1] and the five year average oat yield was 3000 kg ha^{-1}, far below the crops yield potential of 7600 kg ha^{-1}. Oat yield can be increased through appropriate fertilizer application, timely seeding, weed and disease control and reduction of lodging.

Oat yield was responsive to nitrogen fertilizer between 15 and 80 kg ha^{-1} but increased nitrogen may decrease seed weight[3]. Increased nitrogen also increases lodging. Lodging is the permanent displacement of stems from a vertical stance[2]. Lodging can decrease harvestable yield and harvest speed in oat. Plant growth regulators (PGR) may reduce stem length by inhibiting natural gibberellin biosynthesis that occurs during stem elongation[4]. The primary goal of applying a PGR is to reduce lodging and improve harvest-ability.

We investigated the potential to increase oat yield and stand-ability through increased nitrogen rates and the use of an experimental PGR (PGR1).

Objective

To determine the interaction of a plant growth regulator and nitrogen fertilizer rate on Stride oat to improve yield and harvest-ability.

Methods

Trials were conducted at Barrhead, St. Albert, AB and Indian Head, SK in the summer of 2014 in a two factor randomized complete block design with 4 replicates.

Factor 1: four nitrogen rates 5, 50, 100, 150 kg ha^{-1} side-banded urea.

Factor 2: Experimental PGR1 at rates of 0, 70, 100, 130 g.a.ha^{-1}. Stride oat was selected for this experiment due to its high yield potential and lodging susceptibility. PGR1 was applied at 100 L ha^{-1} at growth stage 31, early stem elongation (Figure 2). Data collected included seed yield, plant lodging prior to harvest and plant height at maturity.

Figure 1. Plots treated with N fertilizer and PGR1 showing differences in height .

Lodging ratings were based on a 1-5 scoring system (1 is upright, 2 is leaning at 5 to 30^0, 3 is leaning at 30 to 60^0 , 4 is leaning at angle of >60^0 and 5 is lying on the ground).

Figure 2. Timing of PGR application at BBCH growth stage 30-31. A: BBCH 30, B: BBCH 31,C: dissection of stem to establish staging.

Results

Plant height differed between sites and therefore sites were analyzed separately (Figure 3).At all sites nitrogen fertilizer rates significantly increased plant height (P>0.001). At Indian Head , increasing PGR rate significantly decreased plant height (P>0.001). At St. Albert there was a significant interaction between PGR rate and nitrogen fertilizer rate(P>0.001) and at Barrhead, PGR rate did not significantly affect plant height (Figure 3).

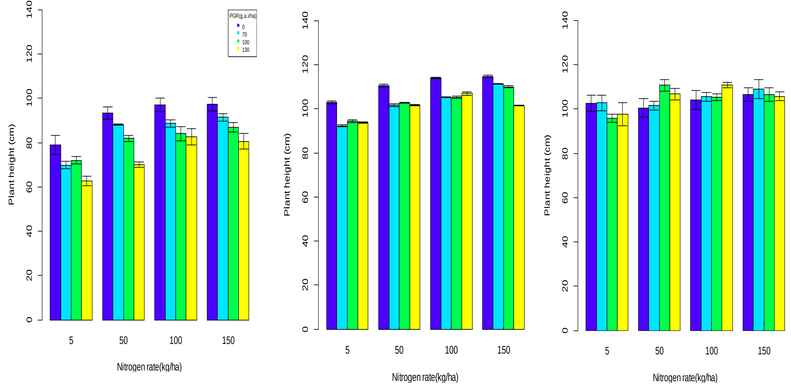

Figure 3. Height (cm) and standard errors of Stride oat response to four nitrogen and PGR1 rates at Indian Head, St.Albert and Barrhead in 2014.

There was minimal lodging at the St. Albert site in 2014, even at high nitrogen rates (Table 1). Preliminary results suggest increased nitrogen rates increased lodging at Barrhead, but increased PGR rates did not consistently reduce lodging. At Indian Head, increased nitrogen rates increased lodging and increasing PGR rate consistently reduced lodging.

Nitrogen	0	70	100	130
kg ha $^{-1}$	PGR g.a.i ha-$^{-1}$			
	St. Albert			
5	1	1	1	1
50	1	1	1	1
100	1	1	1	1
150	1	1	1	1
	Barrhead			
5	1	1	1	1
50	1	1	1	1
100	1.3	1	1	1
150	1.5	1.5	2	1
	Indian Head			
5	1	1	1	1
50	3.3	2.5	2.3	1.8
100	4.3	3.8	2.5	2.3
150	4.8	4.3	2.8	2.3

Table 1. Lodging of Stride oat to four nitrogen fertilizer rates and four rates of PGR1 at St Albert, Barrhead and Indian Head.

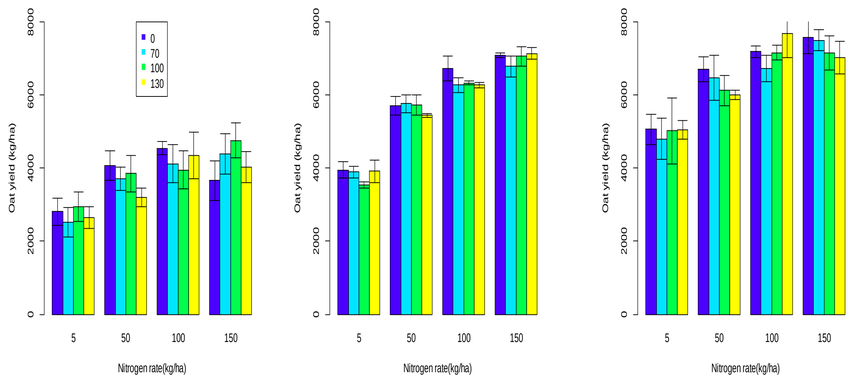

Figure 4. Yield (kg ha^{-1}) and standard errors of stride oat in response to four nitrogen rates and PGR 1 rates at Indian Head, St.Albert and Barrhead in 2014.

Average yields differed between sites and therefore sites were analyzed separately (Figure 4). Indian Head had the lowest average yield and Barrhead the highest. At all sites , yield increased with increasing nitrogen fertilizer rate (P<0.05). PGR application did not have a significant effect on yield and there was no interaction between nitrogen and PGR rates.

Conclusions

Differences between sites influenced plant height, the presence of lodging and yield response to nitrogen fertilizer and PGR rates. At all sites ,increased nitrogen rates increased yield and at two of the three sites also increased plant height. PGR reduced plant height at two of the three sites but did not did not consistently decrease lodging.

Further research is required to determine if PGRs can allow oat growers to increase nitrogen fertilizer rates and yield, without a lodging penalty. Along with varietal choice, early seeding and pest management the yield and quality of oats grown in Alberta may reach the crops genetic potential.

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